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ABSTRACT

This study investigated the effectiveness of a shared, Intranet learning environment on problem-solving ability and reflective metacognition. Subjects were 78 9th and 10th grade biology students from three public high schools in Texas. Research focused on the following questions: (1) Will the use of a shared, Intranet environment improve learner problem-solving ability in science as measured by pre- and posttesting? (2) Will the use of a shared, Intranet environment increase learner metacognitive reflection as measured by use of pre- and posttest visual learning software (Inspiration) that measured the number of concepts used, number of concept links used, and number of concept nodes used to determine changes in learning thinking patterns, and by World Wide Web-based CourseInfo software tracking capabilities within a threaded discussion site? and (3) Will gender differences emerge with the use of a shared, Intranet environment in the science area as determined from pre- and posttest scores measuring problem-solving ability and metacognitive reflection? Results indicated that learning behaviors within science Web-based environments provide support for this learning environment model. (AEF)

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The Effect of a Shared, Intranet Science Learning Environment on Academic Behaviors

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Abstract: As technology continues to make its way into daily classroom use throughout all disciplines and across all grade levels, the question of its impact and effectiveness is heard in rising crescendo. This study investigated the effects of a shared, Intranet science interactive learning environment on the academic behaviors of problem-solving and metacognitive reflection. Results indicate that learning behaviors within science web-based environments provide support for this learning environment model.

1. Introduction and Rationale

As the Intranet is introduced into the learning environment comprising the classroom today, the effects of this technology must be investigated. Technology offers opportunity to affect academic behaviors such as problem-solving ability and metacognitive reflection.

As technology creates a virtual classroom environment as it moves to a web-based space, research must be conducted to determine the effectiveness of geographically unrestricted, collaborative problem-solving (Jacobsen and Levin, 1993). This type of collaboration becomes possible when the learning environment is placed on a web of computers, thereby facilitating access by many to the same place on the Intranet.

As students use the collaborative capabilities of a networked Intranet learning environment, thinking about their own thinking evolves, thereby increasing the opportunity to clarify misconceptions of knowledge, procedural or declarative. The science classroom presents one opportunity to study the effects of a shared, Intranet environment on student problem-solving ability and metacognitive reflection skills.

The purpose of this study was to investigate the effectiveness of a shared, Intranet learning environment on problem-solving ability and reflective metacognition on 9th-10th grade biology students. Should any gender differences emerge within this shared, Intranet environment arise, they were studied.

2. Research Questions

1. Will the use of a shared, Intranet environment improve learner problem-solving ability in science as measured by pre- and posttesting?
2. Will the use of a shared, Intranet environment increase learner metacognitive reflection as measured by use of pre- and posttest visual learning software (Inspiration) as measured by a) number of concepts used, 2) number of concept links used, and 3) number of concept nodes used to determine changes in learner thinking patterns, and by web-based Course Info software tracking capabilities within a threaded discussion site and?

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3. Will gender differences emerge with the use of a shared, Intranet environment in the science area as determined from pre- and posttest scores measuring problem-solving ability and metacognitive reflection?

3. Methodology

Subjects: Subjects for this study were first time 9th and 10th grade biology students from three public education high schools in the Conroe ISD within Conroe, Texas. The sample (n) contained 78 students of the 1400 students enrolled in Biology I courses. Two classes from each school were selected and randomly assigned to a control class and a treatment class. Selected campuses operated on an A-B, 90-minute class alternating block schedule. Classes operating on this type of schedule met certain classes three (3) days per week and two (2) days per week alternating every other week. The sample population included male and female subjects.

Technology: Groups assigned to treatment groups received access to technology. This technology included MacIntosh platform computer labs or classroom computers. All treatment groups accessed minimally 6 computers and maximally 10.

Scanners, digital cameras, and Internet-connected computers, and laser printers rounded out the technology utilized by the treatment groups. Software access included Apple QuickTake PhotoNow software, HP scanning software, MS Office, Netscape Navigator Gold 3.0, and Inspiration 4.0.

Ecology Curriculum: To limit any physical risk each teacher at selected campuses will receive an Adopt-a-Ditch ecology curriculum (Stone and Myers, 1994). The researcher provided training for all curriculum lessons, use of the LaMotte Freshwater Testing Kits, web-based database, and administration of all pre and posttesting instruments. Intentional Intranet discussion forum topics were generated by teachers and the researcher during the training sessions. Spontaneously generated forum topics were noted as the researcher analyzes collected data within the web-based learning environment.

Teacher Training: Training occurred over a three day time period for 2 hours each day. An additional 1.5 hrs. of on-site training session ended the teacher training sessions. All training occurred prior to research initiation. Each teacher received complimentary computer diskettes upon completion of each training session.

Technology training consisted of instruction and practice in the use of the CourseInfo Intranet simulation software (Blackboard, Inc., 1998) Inspiration (Inspiration Software, Inc., 1994) uploading and downloading files via the Internet, digital camera use and downloading of images, use EXCEL spreadsheet/graphical capabilities, and use of the Discussion Forum environment.

All teacher training sessions involving the La Motte Freshwater Testing Kit focused on MSDS safety sheets, general safety practices, disposal of used testing solutions, disinfecting procedures following field work, understanding each freshwater test, and practicing testing techniques (LaMotte, Inc). All teachers received a pail of kitty litter for use during the study. This training insured the highest standard of safety would be established by each teacher in the study and maintained for all class sessions where necessitated by the curriculum content.

Training involving discussion and overview of the ecology curriculum document was incorporated into each training day. Both treatment and control version curriculum documents were used in this training.

Instruments: Treatment and Control groups were randomly assigned at each campus by the principal investigator. Both treatment and control groups on each campus were taught by the same teacher. Several instruments were used to discern problem-solving ability and metacognitive reflection both in the treatment and control groups of this study.

Problem-Solving Ability

The Watson-Glasser Critical Thinking Appraisal was used to measure student's problem-solving ability (Psychological Corp., 1990). The Watson-Glasser was selected due to its design to measure certain aspects of critical thinking including 1) the abilities to recognize problems, 2) evaluate evidence cited to support claims for truth, 3) reason inferentially, and 4) apply the preceding to problems. The test included norms for high students that were developed systematically for this grade level. Its reading level was ninth grade and the mental skills it demands were probably above that. The test could be administered in a group setting, and was timed at 40 minutes which "fit" the campus classroom schedule of the treatment and control groups. Validity of the test was more than acceptable when assessing instructional programs. Evidence supports several aspects of the construct validity of the Watson-Glasser instrument. This instrument was used for assessing problem-solving for both the treatment and control groups.

Metacognitive Reflection

Metacognitive reflection was measured through use of student-generated concept maps developed with the visual learning software program Inspiration (Inspiration Software, Inc., 1994). Concept maps were reduced by 1) the number of concept used, 2) the number of concept links used, and 3) the number of concept nodes used. As part of a secondary research question, an evaluative analysis of the CourseInfo software was undertaken. The tracking capabilities of the software CourseInfo were evaluated through measurement of 1) log-ons to the threaded discussions webpage, 2) number of threaded statements, 3) number of threaded dialogue statements of response to other student statements, and 4) number of threaded dialogue statements of response to teacher statements. Analysis of tracking user movement within the shared web-based environment gave some indication of problem-solving and metacognitive reflection abilities within the environment.

4. Findings

In answering the first question [Will the use of a shared, Intranet environment improve learner problem-solving ability in science?], group means indicated no support for problem-solving improvement. While groups did not differ significantly in terms of problem-solving ability, results from t-Test analysis suggested slight movement toward improvement as a result of exposure to the shared Intranet environment. Significant support for increases in problem-solving ability were seen when individual differences, as measured by paired analysis, were employed. When consideration was given to the individual nature of problem-solving ability, these findings indicated even clearer support for the use of collaborative, constructive, and connected technologies in the potential increasing problem-solving abilities. Use of these technologies within the framework of the science classroom because of the problem-based opportunities appears productive and naturalistic. By providing the contextualization for meaningful inquiry meaning-making thrives and re-application of that meaning to new, problematic situations increases. Problem-solving, or critical thinking, within the context of

web-based shared, learning environments strongly indicates additional research be undertaken to further address the learning behavior.

The scrutiny of length of exposure to this environment becomes an important one. Much research supports lengthy time periods of exposure to shared learning environments as methods connected to increased problem-solving ability (CSILE, 1989; Ryser, Beeler & McKenzie, 1995). Yet, exceptionally small numbers of studies have been undertaken to discern the effect of compacted time periods focused on increasing problem-solving abilities (Abeygunawardena, 1997). A limitation of this study would appear initially as the short timeframe allotted to the study. However, the timeframe utilized represents the reality of many science approaches currently in use. The findings of this study become more relevant given the design methodology mirroring classroom realities. The significant findings for paired differences should continue to be studied, but should also be taken as potential methods for increasing problem-solving ability. While this study does not address all possible questions of what increases problem-solving ability, it does examine one particular model, that of a shared, Intranet science learning environment. Through this examination results indicate the possibility this environment has as one method for potentially impacting problem-solving ability. As the length of time of the study is considered in concert with problem-solving ability, one continues to ask if something else was at work contributing to this increase in problem-solving ability over this short duration. This query leads to the discussion of research question two.

Data analysis of research question two [Will the use of a shared, Intranet environment increase learner metacognitive reflection as measured by use of pre- and posttest visual learning software as measured by a) number of concepts used, 2) number of concept links used, and 3) number of concept nodes?] indicated significant support for improved metacognitive reflection when measured by number of concepts, number of concept links, but not number of concept nodes used. Use of the visual learning tool accessing the concept maps within the shared, Intranet learning environment improved the amount of reflective thinking in which learners engaged at significant levels. Both group means and paired analyses supported changes in metacognitive reflection at significant levels.

The power of metacognitive reflection has been well-documented (Jonassen, 1996). The construction of individual representations allows learners to monitor and facilitate their own problem-solving (Gordon, 1996). The process of metacognitive reflection appears to become inextricably connected to problem-solving ability. Add to this process the multiplicative power afforded by a shared, Intranet learning environment and the element of time, as linked to improvement at individual levels of problem-solving, appear to become compacted. The results of this study robustly support the use of visual learning software (concept mapping tools) within a shared, Intranet learning environment to improve not only metacognitive reflection, and thusly problem-solving ability in a less direct way.

The robust results of improvement of metacognitive reflection within the shared, Intranet learning environment and the interwoven connection to problem-solving ability seem to suggest a model for the improvement of problem-solving ability within shorter timeframe constraints. Further research seems warranted, as well as worthwhile.

In addressing research question three [Will gender differences emerge with the use of a shared, Intranet environment in science for the academic behaviors of problem-solving ability and metacognitive reflection?] Analysis of gender differences in problem-solving ability and metacognitive reflection indicated no levels of significant differences. Group means and paired analyses for problem-solving ability and metacognitive reflection showed no differences with the

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shared, technology-supported science setting. At first glance these findings shape themselves as contradictory to landmark gender studies (Bailey et.al., 1992). However, when the shared, Intranet environment is scrutinized, a cooperative and collaborative nature reveals itself. Environments of this type seem to appeal, and rank high, with the feminine gender(Miller, Chaika & Groppe, 1996). The lack of significant gender differences in problem-solving and metacognitive reflection resulting from the shared, Intranet learning environment strongly suggests an equalizing effect (Loyd and Gressard, 1989). This shared technology-supported learning environment may pose one model which science classrooms can use to create equal opportunity in scientific endeavor for both genders. At the very least the lack of any significant differences as a result of the environment presents potential for a model of improvement of problem-solving ability and metacognitive reflection which crosses all boundaries of gender.

5. Future Implications

The results of this study present one practical model for infusing technology into the classroom setting, for improving problem-solving ability and metacognitive reflection over a short duration, for creating a collaborative, cooperative learning space, and for maintaining a science space for learning where no gender differences arise.

The power an Intranet offers within the constraints of a school district, or geographic locale, have not yet been tapped. This study proposes one mechanism for doing just that given the infrastructure present or absent through the use of a web-based Intranet. This model offers a "get your feet wet" method of networked connectivity for classrooms and teachers who have not yet jumped into the world-wide web.

This research provides a study in contextualizing connectivity with end goals of improved problem-solving and metacognitive reflection. Both of these elements are often lost when initial attempts to jump into networked learning occur or are contemplated. Further, this study provides an avenue of documenting the nature of learning during the use of web browsing or other networked connections. Tracking learner movements within a browsed website has metacognitive as well as problem-solving implications for each and every learner.

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